ETOOSINDIA
INDIA'S NO.1 ONLINE COACHING

Biodiversity and its Conservation

CONTENT

SYLLABUS

Biodiversity and its Conservation

Number of Species on Earth, Number of Species in India, Pattern of Biodiversity, Causes of loss of Biodiversity, processes of extinction of biodiversity,

Conservation of Biodiversity

Name : _____   Contact No. _____

Biodiversity means diversity or heterogeneity at all levels of biological organization, i.e. from macromolecules of the cells to the Biomass. The term Biodiversity was popularized by the sociologist - **Edward Wilson.**

The important levels of biodiversity are

1. Genetic diversity   2. Species diversity   3. Ecological diversity

1. Genetic diversity

It is the diversity at genetic level, or at subspecies level, i.e. below species level, in a single species. For example there are about 1000 varieties of mango *(Mangifera indica)* and 50,000 strains of rice. There are variations in the concentration of chemical in the medicinal plants. The genetic diversity helps the population to adapt, If a population has more diversity it can adapt better to the changed environment conditions. The low diversity leads to uniformity. The genetic variability is therefore, considered to be the raw material for speciation.

2. Species diversity

The measurement of species diversity is its richness, i.e. the number of species per unit area. The greater is the species richness the more will be the species diversity. In nature, the number and kind of species, as well as the number of individual per species, vary, and this leads to greater diversity.

3. Ecological diversity

It is the diversity at community level. It can be of 3-types

(a)   **Alpha (α) diversity -**

It is the diversity of organisms within the *same community or habitat*.

(b)   **Beta (β) diversity -**

It is the diversity *between communities or different habitats*. Higher heterogenecity in the altitude, Humidity and Temperature of a region, the greater will be the dissimilarity between communities, and higher will be the β diversity.

(c)   **Gamma (γ) diversity -**

It is the diversity of organisms over the *entire geographical area,* covering several ecosystems or habitats and various trophic levels and food webs. Such diversity is most stable and productive.

Number of species on earth

It is difficult to believe that there are 20,000 species of orchids, 20,000 species of ants, 28,000 species of fishes and about 3,00,000 species of beetles on earth. According to IUCN (International Union for Conservation of Nature and Natural resources) estimates, the total number of animal and plant species, described so far, is more than 1.5 million. Due to project **'Species 2000'** and **'Global Biodiversity Information',** the new species are being discovered faster than ever before. However, the discovery and description of species is more complete in temperate than in tropical countries. A large number of species are waiting to be discovered from tropics.

According to estimates of **Robert May**

■   The global species diversity is about 7 million (1.5 million, i.e. 22% reported till now and 78% are yet to be discovered).

■   More than 70% of all the species recorded are animals. Plants are not more than 22% of the total.

■   Among animals also, about 70% are insects.

■   The Fungi have more species than all the vertebrates species combined.

■   In case of vertebrates, the species of fishes are more than that of birds, and of latter, more than reptiles.

■   In case of plant species, the species of fungi > species of angiosperms > species of algae.

The all above estimates do not give any idea for the number of species of prokaryotes, whose species diversity may run in millions.

Number of species in India

India is one of the 12 mega diversity country of the world. It has 2.4%, i.e., 1/40 of world land area, but global species diversity is 8.1%, i.e. 1/12. In India the number of animal and plant species recorded so far is 90,000 and 45,000 respectively.

According to **May's** global estimates, about 3,00,000 animals species and 1,00,000 plant species are yet to be discovered from India.

(A large number of species are facing the threat of extinction even before they are discovered, i.e. 'Nature's biological library is burning even before we catalogue the titles of all the books stocked there').

Pattern of Biodiversity

Biodiversity varies with the change of altitude and latitude. The *species diversity is maximum in plants (low altitude) and equator (low altitude).* As we move from lower to higher latitude (from equator to poles) or from lower to higher altitude, the biological diversity decreases. The diversity also depends upon seasonal variability and physical environment like temperature, humidity etc.

Thus the diversity of animals and plants is not uniform throughout the world and shows uneven pattern. There are 2 specific patterns of biodiversity.
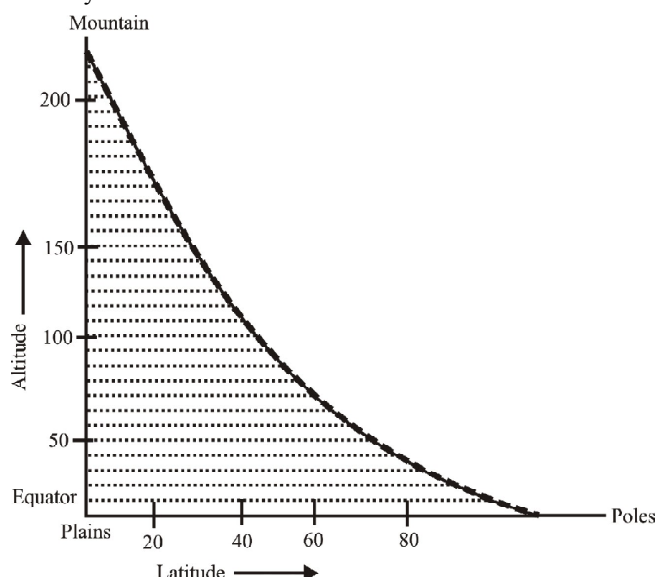

Fig. : Distribution of Ant species at different altitudes & latitude

1. **Latitudinal pattern**

   The species diversity is the maximum at equator and decreases as one moves towards poles. The tropical diversity is highest between latitudinal ranges of 23.5°N to 23.5°S. For example, Columbia, near equator, has about 1400 species of birds, while New York (41°N) and Greenland (71°N) have 105 and 56 species only.

   A forest of tropical regions, like Ecuador, has ten times more species of vascular plants as compared to the forest of temperate region, like mid-west USA.

   The tropical Amazonian rain forest of S. America, has the greatest biodiversity on earth, and has about 30,000 species of fishes, 1300 species of birds, about 400 each of amphibians, reptiles and mammals, and 1,25,000 species of invertebrates. There are about 2 million species of insects and about 40,000 species of plants.

   There are 3 *explanations or hypothesis* for the greater biodiversity in tropics

   1. The tropics have remained relatively undisturbed for million of years. There have been no frequent glaciations as in temperate and hence, long evolution time for species diversification.

   2. The tropic environments are more constant or less seasonal.

   3. Tropics have more solar energy, contributing to higher productivity, hence greater diversity.

2. **Species – Area relationship**

The German naturalist and geographer, **Alexander Von**

 Humboldt, while exploring South American jungles, observed that species – richness increased with increasing explored area, but only up to a limit. This relationship between species richness and explored area is a rectangular hyperbola, described by the equation –

$$S = C A^Z$$

Where S is species richness; C is Y-intercept ; A is area and

Z is the slope to the line (regression coefficient).

Fig. : Species – area relationship

on a logarithmic scale, the relationship is a straight line, described by the equation -

$$Log\ S = Log\ C + Z\ log\ A$$

Ecologists have discovered that value of 'Z' always lies in the range of 0.1 to 0.2, irrespective of the taxonomic group (angiosperm, fish or bird), or the region/ geographical area. This means that the slope of the regression line is amazingly similar. But, if one analyses the species – area relationship in a very large area, like the entire continent, the slope of the line is much steeper (Z - value in the range of 0.6 to 1.2).
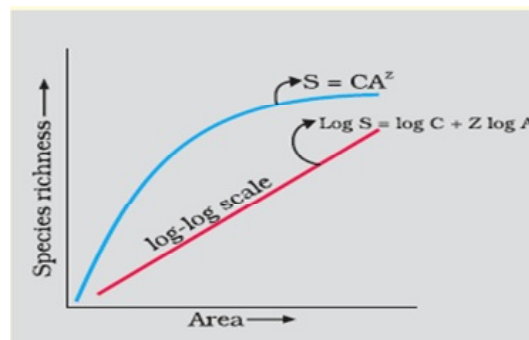
Relationship between species diversity and ecosystem

Most of the ecologists believe that

- The communities with more species are more stable than those with lesser species.

- The stable community means lesser variations in productivity from year to year.

- The community with more species, is more resistant to occasional (natural or man made) disturbances.

- Such communities are resistant to invasions by alien or exotic species.

    David Tilman, in his long term ecosystem experiments, found that plots with more species showed less - year to year variation in total biomass and the increased diversity contributed to higher productivity.

    Thus the rich biodiversity is not only essential for the health of the ecosystem but also for the survival of human race on this planet.

Loss of biodiversity

There is continuous loss of the earth 'treasure of species. For example, the colonization of tropical pacific Islands by human has led to extinction of more than 2000 species of native birds.

The Red list of IUCN documented the extinction of 784 species in last 500 years. the last 20 years witnessed the disappearance of 27 species.

Some important examples of recent extinctions are

Dodo (Mauritius), *Quagga* (Africa), *Thylacine* (Australia), *Steller Sea-cow* (Russia), and subspecies of Tiger, like *bali, javan* and *caspian*.

Presently, more than 15,500 species world - wide are facing the threat of extinction. This includes 32% of amphibian species, 23% of mammalian species and 12% of birds' species. About 31% of the gymnosperms species are also facing the extinction. The amphibians are however more vulnerable in such cases.

From origin to evolution of life on earth, i.e. duration about 3 billion yrs., there have been 5-episodes of mass extinction, but the present, the 6th, mass extinction is 100 to 1000 times faster than the pre-human extinctions. The ecologists now warm that in next 100 years about 50% of all the species on earth will be wiped out. The loss in biodiversity of a region leads to

1. Lowered resistance in environmental changes

2. Decline in the plant production

3. Increased variability in certain ecosystem, pest disease cycles and water use etc.

Causes of loss of biodiversity

The accelerated rate of species-extinction is largely due to human activities. There are 4-major causes, called

'The Evil Quartet', for the loss of biodiversity –

1. Habitat loss and fragmentation
2. Overexploitation
3. Invasion of Alien or exotic species
4. Co- extinctions

1. Habitat loss and fragmentation

The cutting trees and burning of forest destroys the natural habitat of a species. The construction of mines, dams, harbors, industries and buildings for human settlement has also affected the biodiversity. The *Habitat destruction is the primary and major reason of the loss of biodiversity.* The tropical rain forest is the example of the habitat loss where forest covering has been reduced from 14% of land surface to 6%.

The Amazon rain forest, called *'The Lungs of the Planet',* which harbors millions of species, is being cleared for cultivating soybean or developing grasslands for raising cattle. The pollution is also the factor for degradation of habitat.

When large habitats are broken into small fragments due to various human activities, the population of migratory animals, mammals and birds, that require a large territory, are adversely affected.

2. Overexploitation

When human need turns to human greed, for food and shelter, it leads to overexploitation of natural resources. Many species – extinction, like that of Stellar sea-cow and Passenger pigeon, in last 500 years, are due to overexploitation by humans. Many marine fishes are also being over harvested. Over fishing from a water body, or over harvesting a product is just like *'killing a goose laying golden eggs'.*

3. Invasion of Alien or exotic species

When alien species are introduced into an explored area, some of the species turn invasive and cause decline or extinction of indigenous species. For example –

*   Introduction of **Nile perch** into lake Victoria (E. Africa) led to the extinction of more than 200 species of Cichlid fish in the lake.

*   Introduction of weed species, like **Carrot grass** *(Parthenium),* Lantana and **water hyacinth** *(Eicchornia)* has posed threat to the native species and damage to environment.

*   The illegal introduction of **Africa cat fish** *(Clarias gariepinus)* for aquaculture purposes into the river has threatened indigenous cat fishes.

4. Co-extinctions

Whenever a plant or animal species becomes extinct, its obligatory-associated species also becomes extinct. For example, when a host species becomes extinct, the parasite also meets the same fate. In case of *'plant pollinator mutualism'* the extinction of one species leads to the extinction of the other.

Processes of extinction of biodiversity –

1. Natural extinction –

With the change of environmental conditions some species have disappeared and the more adaptive species have appeared. This extinction is slow and is called **'Background extinction'.**

2. Mass extinction –

It is extinction of large number of species due to natural calamities/catastrophies. The extinction of *Dinosaurs* is one such example.

3. **Anthropogenic extinction –**

It is the disappearance of species due to human activities. This man-made extinction represents a severe depletion of biodiversity in terms of time. The current rate of extinction is thousands times higher than the background extinction.

If the current rate of losses continues the earth may lose up to 50% of the species by the end of 21st Century.

Susceptibility to extinction –

The species with the following features are more susceptible (vulnerable) to extinction than the other species.

1.   Larger body size (eg. Elephant, Bengal Tiger and Lion etc.)

2.   Smaller population with low reproductive rate (eg. Blue whale and Giant panda)

3.   Fixed habitat or migratory route (eg. Whooping cranes and Blue whales)

4.   Feeding at higher trophic level in the food chain (eg. Bengal tiger and Bald Eagle)

5.   Narrow range of distribution (eg. Island species and woodland caribou)

Conservation of Biodiversity

Conservation means management of human-use of the biosphere so that it may yield greatest long term (sustainable) benefits for the present generation by maintaining its potential to meet the needs and aspiration of future generations.

Strategies of conservation -

1.   The threatened species should be protected *in-situ* or *ex-situ*

2.   Critical habitats should be safe guarded.

3.   Unique ecosystems should be protected.

4.   Planning and Management of the land and water use.

5.   Utilization should not exceed the productive capacities.

6.   The international trade of wild life organisms or their products should be regulated by legislature and administrative measures.

The reasons for conservation of biodiversity can be grouped into three categories

1.   Narrowly utilitarian   2.   Broadly utilization   3.   Ethical reasons

1. **Narrowly utilitarian**

According to them, the conservation is obvious since human directly derives several economic benefits from biodiversity / nature, like food (cereal, pulses, and fruits), industrial products (lubricants, dyes, resins, perfumes, tannins etc.), medicinal products, firewood and fibres etc.

About 25% of the drugs in the world market are derived from plants.

No body knows how many medicinal plants are still unexplored in tropical rain forest.

2. **Broadly utilitarian**

They believe that biodiversity plays major role in ecosystem or nature. For example, the Amazon rain forest, through photosynthesis, produces 20% of total oxygen in the earth's atmosphere. The economic value of such services can not be estimated in money.

The Pollination, without which the plants can not give fruits or seeds, through pollinators like bees, bumble bees, birds and bats, is another such service that ecosystem provides. We also get aesthetic pleasure when we walk through full bloom flowers in spring and listen to the melodious songs or bulbul or cockoo.

3. **Ethical reasons**

There is spiritual and philosophical need for the conservation of biodiversity. It is our moral duty to take care for the well being of each and every species.

CONSERVATION OF BIODIVERSITY

The **Conservation of biodiversity** can be in *situ* (on site) or *ex situ* (off site) –

1. In situ conservation

In such conservation the endangered species are protected in their natural habitat with entire ecosystem. The conservationists, on global basis, have identified certain **Biodiversity Hot Spots** (with high level of species richness and high degree of endemism).

(The endemic species are the ones which are confined to a particular region and are not found any where else). The hot spots are also the regions of accelerated habitat loss. The number of such hot spots is now 34. These hot spots cover only 1 to 2 percent of earth's land area, but according to one estimate, the strict protection in them can reduce the ongoing mass extinction by almost 30%.

The 3-biodiversity hot spots of India, that cover rich-=biodiversity regions, are

1. Western Ghat
2. Himalaya
3. Indo-Burma

The *in situ* conservation, in India, is done through 15 – **Biosphere reserves, 90 - National Parks**, more than 450 **sanctuaries** and several **Sacred Groves** or the tracts of forests.

1. Biosphere reserves –

They represent natural biomass which contain unique biological communities. They include land as well as coastal environment. Biosphere reserves were created under **MAB** (Man and Biosphere) programme of **UNESCO** in 1971. Till May 2000 there were 408 biosphere reserves in 94 countries of the world. In India there are 15 biosphere reserves. There are 3-zones in a biosphere reserve.

1. **Core (natural) zone -** It is inner most zone which is legally protected and completely undisturbed from human interference,

2. **Buffer zone -** In this zone limited human activity is allowed for research and education purposes.

3. **Transition (manipulation) zone -** It is the outermost zone of biosphere reserve in which large number of human activities are permitted, eg. Cultivation, domestication, harvesting of natural product, grazing, forestry, settlement and recreation etc. In this zone the traditional life style of tribals is protected with their live-stock.
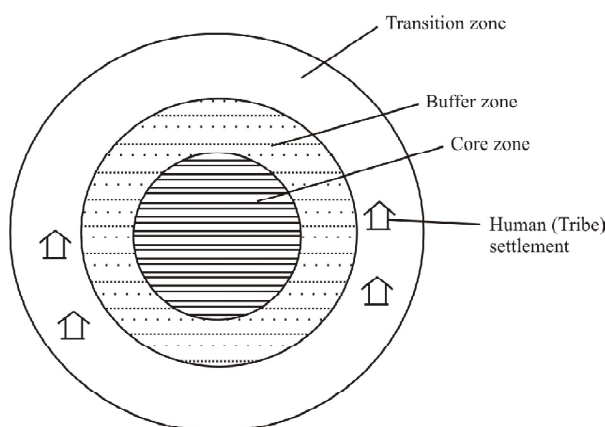

Fig. : Different zones of a Terrestrial Biosphere reserve

Functions of biosphere reserves –

1. For conservation of landscape, ecosystem and genetic resources.
2. For economic development
3. For scientific research, education and for exchange of information at national and global level.

In India the first biosphere reserve, **Nilgiri** *was declared in* **1986**. It includes parts of Karnataka, Kerala and Tamilnadu. The list of biosphere reserves of India is given below :-

1. Nilgiri
2. Nandadevi
3. Uttrakhand
4. Nokrek (Meghalaya)
5. Andamans
6. Simlipal (Orissa)
7. Kaziranga (Assam)
8. Gulf of Mannar (T.N.)
9. Thar Desert
10. Sundarbans (W.B.)
11. Kanha (M.P.)
12. Runn of Kutch (Guj.)
13. Nicobar
14. Manas (Assam)
15. Namdapha (Ar. P.)

2. **National Parks**

They are reserved for the betterment of wild life, both **funna and flora.** In national parks private ownership is not allowed. The grazing, cultivation, forestry etc. is also not permitted. The first important state wise national parks of India are –

| Name of State	Names of National Parks with Specific animals
1. Assam	Kaziranga (Rhinoceros) Manas*
2. Bihar	Valmiki, Palampau*
3. Chhatisgarh	Indravati, Guru Ghasidas
4. Gujrat	Gir (Asiatic Lion), Marine
5. Jammu & Kashmir	Daschigam (Kashmir Stag), Salim Ali
6. Jharkhand	Hazaribagh
7. Karnataka	Bandipur
8. Kerala	Silent valley, Periyar
9. Madhya Pradesh	Kanha*, Sanjay, Madhav, Panna, Bandhavharh*, Van Vihar, Fossil
10. Meghalaya	Nokrek
11. Odisha	Simplipal
12. Rajasthan	Sariska*, Ranthambore*, Desert
13. Uttarakhand	Corbett* (Hailey), Nanda Devi, Valley of flowers, Rajaji
14. Uttar Pradesh	Dudhwa*
15. West Bengal	Sunderbans

* These National Parks are running **Tiger Project** also. (The *maximum national parks are present in Madhya Pradesh and Andaman and Nicobar Islands*)

3. **Sanctuaries –**

In sanctuaries the protection is given to **fauna** only. The activity like harvesting of timber, collection of forest products and private ownership rights are permitted so long as they do not interfere with the well being of the animals. The important wild life sanctuaries are Chika wild life sanctuary **(Orissa)**, Bharatpur Bird Sanctuary **(Rajasthan)**, Sultanpur Bird Sanctuary **(Haryana)** and Jalpara sanctuary **(West Bengal)**. Maximum sanctuaries belong to Andman and Nicobar. The **Project Tiger** was launched in India in year **1973** with the assistance of **WWF** (World Wild life Fund) after the recommendation of **IBWL** (Indian Board of Wild Life). At present there are more than 20 tiger projects. (**WWF** after its silver jublilee in 1986 has been renamed as **World Fund for Nature (WFN).** The symbol of **WWF** is **Giant Panda.**

In India National Parks and sanctuaries were created after formulation of **Wild Life (protection) act** in **1972.** (This act was amended in 1991).

4. The sacred groves are found in Khasi and Jaintia hills (Meghalaya), Aravalli hills (Rajasthan), Western Ghats (Karnataka and Maharashtra) and Sarguja, Chanda and Bastar areas of Madhya Pradesh.

Biodiversity conservation
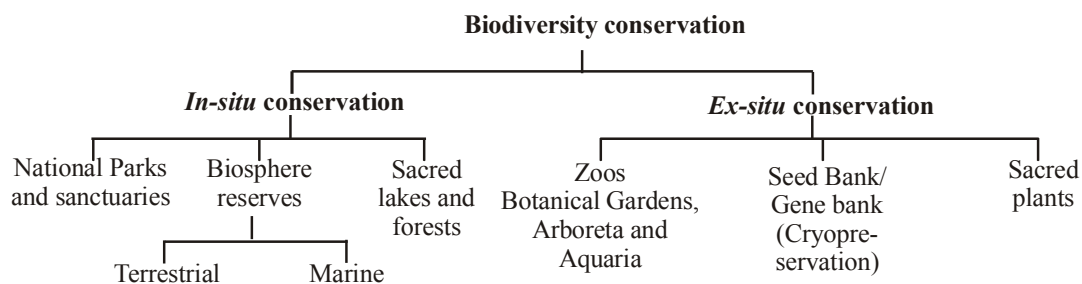
2. *Ex situ* **conservation**

In such type of conservation the threatened animals and plants are taken out of their natural habitat and are protected in special parks or areas like, **Zoological parks, Wild life safari parks** and **Botanical gardens*** etc. The *ex situ* conservation also includes

- **Cryopreservation** of gametes of threatened species in viable and fertile form.

- Fertilization of eggs in *vitro* and propagation of plants through '**Tissue culture methods'**

- Preservation of seeds through **Seed banks**

The historic conservation on Biodiversity, **'The Earth Summit'** was held in **Rio de Janeiro** (Brazil) in 1992. In a follow-up, in 2002, through **'World Summit on Sustainable development'** in **Johannaesburg** (S. Africa), one hundred and ninety countries pledged their commitment for a significant reduction in current rate of biodiversity-loss at global, regional and local level, by 2010. The next summit for the cause of biodiversity is to be held in 2012.

(*Botanical gardens – There are about 1500 botanical gardens and **arboreta** (a place where specific species of trees or shrubs are cultivated for research or display) in the world. They contain more than 80000 species. Some botanical gardens also have facilities of seed bank tissue culture.)